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(71) Applicant: HEALTHSHIELD TECHNOLOGIES L.L.C. [US/US]; 67 Prospect Avenue, Suite 201, West Hartford, CT 06106 (US).

(72) Inventors: FREEDMAN, Roger, M.; One Governors Row, West Hartford, CT 06116 (US). TROGOLO, Jeffrey, A.; 228 Commonwealth Avenue, Boston, MA 02116 (US). BARRY, John, E.; 18 Drake Lane, Derry, NH 03038 (US).

(74) Agents: TODARO, John, C. et al.; Darby & Darby P.C., 805 Third Avenue, New York, NY 10022-7513 (US).

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(57) Abstract

An ice chest cooler of rigid expanded plastic foam and method of manufacture having a chest base whose inner surface that is to be in contact with food, the user hand or other objects, contains an inorganic antimicrobial agent which can be a zeolite. The agent is in an effective amount to kill the bacteria. The agent can be incorporated in the resin constituent of the foam, placed on a surface of the mold to be embedded in the surface as the foam expands, or be contained in a coating applied to the inner surface.

COOLER CHEST WITH ANTIMICROBIAL PROPERTIES

Field of The Invention

This invention relates to the field of portable ice chests, or coolers, having antimicrobial surfaces to prevent the growth of bacteria.

Background of the Invention

Portable ice chests, or coolers, are well-known devices. They comprise the chest base into which ice is inserted together with the articles to be cooled, and a lid. The lid can either be separate from and held to the base by a friction fit or else attached by hinges. Usually, the ice chest base and lid are made of a suitable insulating material, such as Styrofoam, which is an expanded plastic resin rigid foam material, by any suitable conventional manufacturing technique.

In use, ice is placed into the chest base for cooling purposes. Various types of food, either in an open or packaged state, are placed into the ice to be kept cool. Often times, such chests are used to transport fish which have been caught by fishermen. In any event, the presence of food in the chest base at one time or another provides the possibility of bacteria being on the chest base inner surface and also gives rise to sites where bacteria can grow. The bacteria can be transported from the chest to other products upon contact by the hand of the user upon placing articles into or removing them from the chest base. The user also can transport the bacteria to other places. Because of these problems, it would be highly desirable to be able to eliminate the source of bacteria growth in an ice chest.

Summary of the Invention

The present invention relates to an ice chest in which at least the inner surface of the chest base, which might come into contact with food, is provided with an inorganic antimicrobial agent. In a preferred embodiment of the invention, the agent is a zeolite. The chest can be made in a variety of ways to incorporate the antimicrobial agent. In one embodiment, the agent is mixed with the plastic resin and comprises a component of the resin mixture used in forming the base and also preferably the lid. Here, the agent is automatically available on all surfaces of the chest. In another embodiment, the agent is applied to the portion of the surface of the mold in which the chest body or lid inner surface is formed. The agent becomes embedded into the chest body or lid inner surface as the item is molded within the mold. In still a further embodiment of the invention a coating that contains the agent is applied to the base inner surface.

Objects of the Invention

It is therefore an object of the invention to provide an ice chest having a surface that includes an inorganic antimicrobial agent.

Still a further object is to provide a method of manufacturing an ice chest having antimicrobial properties.

A further object is to provide an ice chest and method of manufacture in which the inner surface of at least the ice chest base is formed to incorporate an inorganic antimicrobial agent.

Yet another object is to provide an ice chest in which a surface that will come into contact with food contains an inorganic antimicrobial agent.

Brief Description of the Drawings

Other objects and advantages of the present invention will become more apparent upon reference to the following specification and annexed drawings in which:

Fig. 1 is a perspective view of an ice chest made in accordance with the invention to incorporate the antimicrobial surface.

Detailed Description of the Invention

Referring to Fig. 1, a typical ice chest, or cooler, 10 is shown. The chest can be of any suitable size and shape, such as square, rectangular or round. The chest includes a base 12 of suitable depth with a compartment that holds ice and the objects to be cooled. There also is a lid 14 that can be either separate from the base and attached by a friction type fit to close the base open top. The lid also can be attached by a hinge. Each of the base and lid has a respective inner surface 13 and 15.

Typically, the base and lid are made of a suitable expanded cell type plastic rigid foam material having good insulating properties. In the manufacture of conventional foam products, such as of polyurethane or other plastics, the foam constituents, such as polyisocyanate and a polyol, are brought together in a mixing head and then injected or sprayed into the cavity of a suitable mold. The foam constituents expands in the mold to form the final product. After cooling, the finished product is removed from the mold. Various techniques and foam material compositions, such as described in U.S. Patent 5,141,684, can be used to make the inner and outer surfaces of the chest base and lid of higher density. In the manufacture of an ice chest, both the inner and outer surfaces preferably have a higher density to enhance wearability.

The typical process for making an ice chest involves use of a two-part mold, one mold for the base and one mold for the lid. Each mold forms a cavity which defines the general shape of the ice chest base or lid. The composition for forming the foam can be sprayed or injected into the mold cavity. The composition expands on the mold to achieve the desired shape. All of the equipment and processing for forming expanded foam products are well known.

In accordance with the invention, at least the inner surface of the ice chest base compartment is to contain an inorganic antimicrobial agent. The inner surface of the chest base compartment is to be contacted by objects, such as food or the hand of the chest user. Since the base inner surface contains the antimicrobial agent the desired action of killing bacteria or reducing its growth rate is accomplished. The inner surface of the chest lid also can be provided with the inorganic antimicrobial agent, if desired.

Providing the inner surface of the chest base and lid with the antimicrobial agent can be accomplished in several ways.

Incorporating the agent in the resin for the foam – the antimicrobial agent can be incorporated into the resin that it is used as one of the components of the expanded foam, for example, styrofoam. A preferred antimicrobial agent is an antibiotic zeolite and particularly zeolites incorporated as ceramic particles. Suitable zeolites and a method for incorporating them into the resin are generally disclosed in U.S. Patents 4,938,955 and 4,906,464. The resins into which the zeolite is incorporated can be those such as polyurethane, polyethylene, polypropylene, polystyrene, polyvinyl chloride, and others as disclosed in said patents.

In a preferred process for forming the polymer resin constituent of the foaming material used to make the chest, a zeolite is used as the antimicrobial agent. The zeolite is originally in ceramic particle form. The particles can be in a base resin such as polyurethane, polyethylene, polypropylene, polystyrene, polyvinyl chloride, and others.

The zeolite particles in the base resin are then formed in master batches incorporated in pellets of a resin, such as low density polyethylene. For example, ceramic silver zeolite particles, such as AJ10D, made by Shinagawa Company of Osaka, Japan, and which are of a nominal 1.0 micron size, are combined with the resin, dispersed as uniformly as possible, such as by kneading, molding into, etc. The resulting resin product incorporating the zeolite ceramic particles is then made into pellets of a desired size. Other

antimicrobial agents, as described below, are also suitable and would be processed in a manner consistent with the agent and resin used.

The original zeolite particles typically contain up to about 20.0% by weight of the resulting pellets. The zeolite particles are dispersed throughout the pellets, including the surface of the pellets. The pellets can later be reduced to a desired size, such as by grinding.

The base resin of the master batch zeolite containing pellets preferably is selected to be the same as that of the resin to be used as the plastic resin constituent for the expanded foam. The pellets containing the zeolite are thoroughly mixed with the thermoplastic resin that is to be a constituent of the foam resin. The concentration of the original zeolite particles is reduced, preferably to in the range of 0.5 to 10.0 wt% of the resin constituent of the foam product. The foam resin and foaming agent are injected into the mold and it expands. The agent, from the pellets, is available throughout the entirety of the cells of the expanded foam product, here particularly, the inner surface of the chest base.

The antimicrobial particles are preferably present in an effective amount in a concentration by weight in the resin used to form the foam. This means that there is a sufficient amount of the antimicrobial agent added to or combined with other materials, such as the resin constituent of the foam, so as to be on the exposed surface to prevent or inhibit the growth of bacterial and/or fungal organisms or to kill such organisms. The amount of the agent will vary based on the specific inorganic agent used, its composition, the material with which it is mixed or added to and upon known factors such as type and use of the product containing the agent. Environmental factors such as the temperature of the chest base upon being cooled also should be taken into consideration. It is within the ability of one skilled in the art to relatively easily determine an effective amount of the antimicrobial agent to be used with each material.

When the desired resin for the expanded foam is polyurethane, this resin is usually processed in liquid form and is mixed with a cross-linking

agent. To make the liquid equivalent of a master batch of resin pellets that contain the zeolite particles, the zeolite ceramic particles are mixed with the liquid polyurethane. The mixing is thorough to uniformly disperse the zeolite particles. A liquid mixture of the zeolite particles and polyurethane is obtained. Here, as in the case of the pellets, the wt% of the zeolite particles in a master batch concentrate of the polyurethane liquid can be up to about 20.0% of the concentrate.

The liquid concentrate can be mixed with additional untreated liquid polyurethane to form the final resin constituent for the expanded foam with the desired amount of the antimicrobial agent. The mixing should be thorough to uniformly disperse the zeolite particles. Here, the original zeolite particles preferably are present in the range of 0.5 to 10 wt% of the resin constituent of the foam product.

If desired, the zeolite particles can be directly blended with the polyurethane liquid to be used as the resin constituent of the foam without first making concentrate to obtain the desired amount of zeolite in the foam resin constituent. This eliminates the step of making the concentrate.

The polyurethane containing the agent is injected into the mold as a constituent of the foam material. Upon expansion, the agent is present throughout the foam, including the inner surface of the chest base.

Typical ranges of the antimicrobial agent, i.e., original zeolite ceramic particles, in the resin constituent for the foam material have been found to be of from 0.01 to 10.0 wt%, more preferably from 0.01 to 8.0 wt%, and most preferably from 0.1 to 5.0 wt%. The amount of agent in the final product has been reduced from that in the pellets or liquid concentrate.

A preferred embodiment of the cooler chest made from a resin that contains the zeolite according to the invention has:

resin	polyurethane and compatible foaming agent

antimicrobial agent	AJ10D (Shinigawa)
Agent particles/size	1.0 micron
Final wt% of agent in resin used for foam	2.0%

Placing agent on the mold - in this process, particles of agent containing resin are applied to the portion of the mold that forms the inner surface of the ice chest base, and the lid if desired. In one embodiment, pellets are made containing the zeolite particles in a resin material base compatible with the resin constituent of the expanded foam forming the chest base. The pellets are formed to the desired size and are adhered to the mold by pressing them against the mold surfaces. Since the mold surfaces will normally be warm, the adherence of the resin pellets containing the zeolite particles to the mold surfaces will be enhanced. If desired, a light coating of an adhesive can be placed on the mold surfaces to hold the pellets. An effective amount of antimicrobial agent, as described above, is embedded in the mold.

In a conventional manner, the foam composition is inserted into the mold cavity and expands against the mold surfaces. During the expansion of the foam into the chest base, the particles containing the agent on the mold surfaces become embedded in the base inner surface. Thus, they are available for antimicrobial action, as described above.

In a preferred embodiment:

agent particles	AJ10D (Shinagawa)
size of agent particles	1.0 micron
wt. % of agent	5% by weight of the pellets

As an alternative, for example, where the chest is to be of polyurethane, the liquid polyurethane containing the agent particles of a desired concentration is formulated. This liquid is then coated onto the mold surface. The normal foam constituents are injected into the mold before the coating dries. As the foam expands in the mold, the coating becomes the inner surface of the object, here the chest base, that is formed. The inner surface now has the antimicrobial agent. The agent, particle size and wt% of the agent particles in the liquid coated on the mold can be as set forth above for the process in which the pellets are placed on the mold.

Coating the chest base inner surface – in this embodiment the ice chest is formed in the normal manner of the desired rigid expanded foam material and process, preferably one that produces a higher density inner surface. After its formation, a coating which contains the agent is applied to the inner surface of the chest base.

The coating is adhered to the chest base higher density inner surface. Polymer coatings are preferred for this embodiment. The polymers can be of silicone rubber and hydrophilic polymers. The coating preferably can be of, for example, a hydrophilic polymer such as hydrophilic polyurethane, or an acrylic. Particles containing the antimicrobial agent are mixed with the coating material in the desired amount.

The coating with the agent is applied to the inner surface of the chest base by any suitable technique, such as spraying or painting. The agent is available in the coating on the inner surface of the chest base, and lid if so applied, to perform its antimicrobial action.

The agent particles comprise by weight of the coating material of between about 0.1% - 100%, more preferably between about 0.1% - 75%

and most preferably between about 0.5% - 50.0%. As explained above, there is an effective amount of the antimicrobial agent in the chest base.

A typical embodiment of a chest base of the invention with an antimicrobial coating is:

coating material	acrylic
agent	AJ10D (Shinagawa)
agent particle size	1.0 micron
wt% of agent particles in coating	5.0%

In each of the processes the agent is to be present in an effective amount, as described above.

As to the inorganic antimicrobial agent incorporated in the resin or used in the coating, a number of metal ions (cations), which are inorganic materials, have been shown to possess antimicrobial or antibiotic activity, including silver, copper, zinc, mercury, tin, lead, bismuth, cadmium, chromium and thallium ions. These antibiotic metal cations are believed to exert their effects by disrupting respiration and electron transport systems upon absorption into bacterial or fungal cells. Antimicrobial metal ions of silver, gold, copper and zinc, in particular, are considered safe even for *in vivo* use. Antimicrobial silver cations are particularly useful for *in vivo* use due to the fact that they are not substantially absorbed into the body. That is, if such materials are used they should pose no hazard.

In one embodiment of the invention, the inorganic antimicrobial metal containing composition is an antibiotic metal salt. Such salts include silver acetate, silver benzoate, silver carbonate, silver ionate, silver iodide, silver lactate, silver laureate, silver nitrate, silver oxide, silver palpitate, silver protein, and silver sulfadiazine. Silver nitrate is preferred. These salts are particularly quick acting, as no release from ceramic particles is necessary to function antimicrobially.

Antibiotic or antimicrobial zeolites are preferred. These have been prepared by replacing all or part of the ion-exchangeable ions in zeolite

with ammonium ions and antimicrobial metal ions, as described in U.S. Patent Nos. 4,938,958 and 4,911,898. Such zeolites have been incorporated in antimicrobial or antibiotic resins (as shown in U.S. Patent Nos. 4,938,955 and 4,906,464) and polymer articles (U.S. Patent No. 4,775,585). Polymers including the antibiotic zeolites have been used to make refrigerators, dish washers, rice cookers, plastic film, chopping boards, vacuum bottles, plastic pails, and garbage containers. Other materials in which antibiotic zeolites have been incorporated include flooring, wall paper, cloth, paint, napkins, plastic automobile parts, catheters, bicycles, pens, toys, sand, and concrete. Examples of such uses are described in US Patents 5,714,445; 5,697,203; 5,562,872; 5,180,585; 5,714,430; and 5,102,401. These applications involve slow release of antibiotic silver from the zeolite particles which is suitable for components of the grill.

Antimicrobial or antibiotic ceramic particles useful with the present invention include zeolites, hydroxy apatite, zirconium phosphates or other ion-exchange ceramics. Zeolites are preferred, and are described in the preferred embodiments referred to below. Hydroxy apatite particles containing antimicrobial metals are described, e.g., in U.S. Patent No. 5,009,898. Zirconium phosphates containing antimicrobial metals are described, e.g., in U.S. Patent Nos. 5,296,238; 5,441,717; and 5,405,644.

Inorganic particles, such as the oxides of titanium, aluminum, zinc and copper, may be coated with a composition which confers antimicrobial properties, for example, by releasing antimicrobial metal ions such as silver ions, which are described, e.g., in U.S. Patent No. 5,180,585. Inorganic soluble glass particles containing antimicrobial metal ions, such as silver, are described, e.g., in U.S. Patent Nos. 5,766,611 and 5,290,544.

Antimicrobial or antibiotic zeolites are well-known and can be prepared for use in the present invention using known methods. These include the antibiotic zeolites disclosed, for example, in U.S. Patent Nos. 4,938,958 and 4,911,898.

Either natural zeolites or synthetic zeolites can be used to make the antibiotic zeolites used in the present invention. "Zeolite" is an aluminosilicate having a three dimensional skeletal structure that is represented by the formula: $XM_{2/n}$-O-Al_2O_3-$YSiO_2ZH_2O$. M represents an ion-exchangeable ion, generally a monovalent or divalent metal ion, n represents the atomic valency of the (metal) ion, X and Y represent coefficients of metal oxide and silica respectively, and Z represents the number of waters of crystallization. Examples of such zeolites include A-type zeolites, X-type zeolites, Y-type zeolites, T-type zeolites, high-silica zeolites, sodalite, mordenite, analcite, clinoptilolite, chabazite and erionite. The present invention is not restricted to use of these specific zeolites.

The ion-exchange capacities of these zeolites are as follows: A-type zeolite = 7 meq/g; X-type zeolite = 6.4 meq/g; Y-type zeolite = 5 meq/g; T-type zeolite = 3.4 meq/g; sodalite = 11.5 meq/g; mordenite = 2.6 meq/g; analcite = 5 meq/g; clinoptilolite = 2.6 meq/g; chabazite = 5 meq/g; and erionite = 3.8 meq/g. These ion-exchange capacities are sufficient for the zeolites to undergo ion-exchange with ammonium and antibiotic metal ions.

The specific surface area of preferred zeolite particles is preferably at least 150 m^2/g (anhydrous zeolite as standard) and the SiO_2/Al_2O_3 mol ratio in the zeolite composition is preferably less than 14, more preferably less than 11.

The antimicrobial or antibiotic metal ions used in the antibiotic zeolites should be retained on the zeolite particles through an ion-exchange reaction. Antibiotic metal ions which are adsorbed or attached without an ion-exchange reaction exhibit a decreased bactericidal effect and their antibiotic effect is not long-lasting. Nevertheless, it is advantageous for imparting quick antimicrobial action to maintain a sufficient amount of surface adsorbed metal ion.

In the ion-exchange process, the antimicrobial or antibiotic metal ions (cations) tend to be converted into their oxides, hydroxides, basic salts

etc. either in the microforms or on the surfaces of the zeolite and also tend to deposit there, particularly when the concentration of metal ions in the vicinity of the zeolite surface is high. Such deposition tends to adversely affect the bactericidal properties of ion-exchanged zeolite.

In an embodiment of the antimicrobial or antibiotic zeolite, a relatively low degree of ion exchange is employed to obtain superior bactericidal properties. It is believed to be required that at least a portion of the zeolite particles retain metal ions having bactericidal properties at ion-exchangeable sites of the zeolite in an amount less than the ion-exchange saturation capacity of the zeolite. In one embodiment, the zeolite employed in the present invention retains antimicrobial metal ions in an amount up to 41% of the theoretical ion-exchange capacity of the zeolite. Such ion-exchanged zeolite with a relatively low degree of ion-exchange may be prepared by performing ion-exchange using a metal ion solution having a low concentration as compared with solutions conventionally used for ion exchange.

The antimicrobial or antibiotic metal ion is preferably present in the range of from about 0.1 to 20wt.% of the zeolite. In one embodiment, the zeolite contain from 0.1 to 20wt.% of silver ions and from 0.1 to 20wt.% of copper or zinc ions. Although ammonium ion can be contained in the zeolite at a concentration of about 20 wt.% or less of the zeolite, it is desirable to limit the content of ammonium ions to from 0.5 to 15 wt.%, preferably 1.5 to 5 wt.%. Weight% described herein is determined for materials dried at temperatures such as 110°C, 250°C or 550°C as this is the temperature employed for the preferred post-manufacturing drying process.

A preferred antimicrobial zeolite is type A zeolite containing either a combination of ion-exchanged silver, zinc, and ammonium or silver and ammonium. One such zeolite is manufactured by Shinagawa, Inc. under the product number AW-10N and consists of 0.6% by weight of silver ion-exchanged in Type A zeolite particles having a diameter of about 2.5μ. Another formulation, AJ-10N, consists of about 2% by weight silver ion-

exchanged in Type A zeolite particles having a diameter of about 2.5μ. Another formulation, AW-80, contains 0.6% by weight of silver ion-exchanged in Type A zeolite particles having a diameter of about 1.0μ. Another formulation, AJ-80N, consists of about 2% by weight silver ion-exchanged in Type A zeolite particles having a diameter of about 1.0μ. These zeolites preferably contain about between 0.5% and 2.5% by weight of ion-exchanged ammonium. A further product is AJ10D, which consists of about 2% by weight of silver ion exchanged in Type A zeolite particles having a diameter of about 1.0μ.

The antimicrobial properties of the antimicrobial zeolite particles of the invention may be assayed while in aqueous formulations using conventional assay techniques, including for example determining the minimum growth inhibitory concentration (MIC) with respect to a variety of bacteria, eumycetes and yeast. In such a test, the bacteria listed below may be employed:

Bacillus cereus varmycoides;
Escherichia coli;
Pseudomonas aeruginosa;
Staphylococcus aureus;
Streptococcus faecalis;
Aspergillus niger;
Aureobasiduim pullulans;
Chaetomium globosum;
Gliocladium virens;
Penicillum funiculosum;
Candida albicans; and
Saccharomyces cerevisiae.

The assay for determining MIC can be carried out by smearing a solution containing bacteria for inoculation onto a plate culture medium to which a test sample of the encapsulated antibiotic zeolite particles is added in a particular concentration, followed by incubation and culturing of the plate.

The MIC is defined as a minimum concentration thereof required for inhibiting the growth of each bacteria.

Safety and biocompatibility tests were conducted on the antibiotic zeolite employed in the invention. ISO 10993-1 procedures were employed. The following results were obtained:

Cytotoxicity: **Non-Toxic**
Acute Systemic Toxicity: **Non-Toxic**
Oral Toxicity: Safer than table salt
Intracutaneous Toxicity: **Passed**
Skin Irritation Test: **Non-Irritant**
Chronic Toxicity: **No Observable Effect**
In-vitro Hemolysis: **Non-Hemolytic**
30-day Muscle Implant Test: **Passed**
60-day Muscle Implant Test: **Passed**
90-day Muscle Implant Test: **Passed**
Ames Mutagenicity Test: **Passed**
Pyrogenicity: **Non-Pyrogenic**

Thus, the antibiotic zeolites are exceptionally suitable under relevant toxicity and biocompatibility standards for use in the implantable devices.

Specific features of the invention are shown in one or more of the drawings for convenience only, as each feature may be combined with other features in accordance with the invention. Alternative embodiments will be recognized by those skilled in the art and are intended to be included within the scope of the claims. All patent applications, patents, patent publications, and literature references cited in this specification are hereby incorporated by reference in their entirety. In the case of inconsistencies, the present description, including definitions, is intended to control. Accordingly, the above description should be construed as illustrating and not limiting the

scope of the invention. All such obvious changes and modifications are within the patented scope of the appended claims.

We Claim:

1. An ice chest base of expanded rigid plastic resin foam material having an inner surface, said inner surface comprising antimicrobial zeolite particles.

2. The ice chest base of claim 1, wherein said antimicrobial zeolite particles contain silver cations as an active ingredient.

3. The ice chest base of claim 1 wherein said antimicrobial zeolite particles are contained in the resin forming the foam.

4. The ice chest base of claim 3 wherein said zeolite particles are present in the amount of from 0.01 to 10.0 wt% of the resin constituent of the foam.

5. The ice chest base of claim 1 wherein said antimicrobial zeolite particles are present in a coating applied on said inner surface.

6. The ice chest base of claim 4, wherein said coating comprises a polymer selected from the group consisting of a silicone rubber and hydrophilic polyurethane.

7. The ice chest base of claim 5 wherein said zeolite particles are present in said coating in an amount of from 0.01 to 10.0 wt%.

8. The ice chest base of claim 1, wherein said plastic resin foam material comprises a compound selected from the group consisting of polyurethane, polyethylene, polypropylene, polystyrene and polyvinyl chloride.

9. An ice chest comprising the ice chest base of claim 1.

10. The ice chest of claim 9, further comprising a lid of expanded rigid plastic resin foam material having an inner surface, said inner surface comprising antimicrobial zeolite particles.

11. A method of forming an ice chest base with an inner surface containing an inorganic antimicrobial agent comprising:

providing a mold having a cavity of the shape of the ice chest base;

injecting a mixture of a resin and expansion agent into said mold for expansion into said chest base; and

forming the inner surface of said base with an antimicrobial zeolite particles.

12. The method of claim 8 wherein said step of forming the inner surface of said base comprises mixing said zeolite particles with said resin forming the expanded foam.

13. The method of claim 8 wherein said step of forming the inner surface of said base comprises applying said zeolite particles to the portion of said mold that shapes said inner surface and wherein the zeolite particles become embedded into the inner surface as the resin mixture expands and cools.

14. The method of claim 10 wherein said step of forming the inner surface of said base comprises mixing said zeolite particles in a liquid resin and said applying step comprises coating the mold surface with said liquid mixture of zeolite particles and resin.

15. An ice chest base of expanded rigid plastic resin foam material having an antimicrobial inner surface, said inner surface comprising an inorganic antimicrobial agent.

16. The ice chest of claim 12, wherein said inorganic antimicrobial agent contains silver cations as an active ingredient.

17. The ice chest base of claim 12, wherein said inorganic antimicrobial agent comprises ceramic particles.

18. An ice chest comprising the ice chest base of claim 12.

19. A method of forming an ice chest base with an inner surface containing an inorganic antimicrobial agent comprising:

providing a mold having a cavity of the shape of the ice chest base;

injecting a mixture of a resin and expansion agent into said mold for expansion into said chest base; and

forming the inner surface of said base with inorganic antimicrobial particles.

20. The method of claim 19, wherein said inorganic antimicrobial particles contain silver cations as an active ingredient.